REMARKS/ARGUMENTS

New claims 13 and 23 find support in originally filed claims 1 and 3, at page 7, lines 16 ~ 23, of the specification, and in FIG. 1. New Claim 14 is based on originally filed claims 2 and 3, page 7, lines 16 ~ 23, of the specification, and FIG. 8. New Claim 15 is based on page 9, line 3 ~ line 19, of the specification and FIGS. 1, 4, and 9. New Claim 16 is based on original claims 4 and 6, page 7, lines 16 ~ 23, of the specification, and FIG. 1. New Claim 17 is based on original claims 5 and 6, page 7, lines 16 ~ 23, of the specification, and FIG. 8. New claim 18 is based on the description at page 9, line 3 ~ line 19, of the specification and FIGS. 1, 4, and 9. New Claim 19 is based on original claims 8 and 9 and page 8, line 16 ~ line 18, of the specification. New claim 20 is based on page 9, line 3 ~ line 19, of the specification, and FIGS. 1, 4, and 9. New Claim 21 is based on originally filed claims 11 and 12, page 7, line 16 ~ line 23, of the specification, page 8, line 16 ~ line 18 of the specification, page 18, line 4 ~ line 8, of the specification, and FIG. 8. New Claim 22 is based on page 9, line 3 ~ line 19, of the specification and FIGS. 1, 4, and 9. New claim 23 is supported at page 7, lines 16-17, of the specification. No new matter has been entered.

The rejections over Adachi in view of Wognum, and Adachi in view of Wognum, further in view of Jones, are traversed.

Adachi relates to an apparatus for the production of a semisolid shaping metal having fine primary crystals dispersed in a liquid phase. Adachi discloses a nucleating section 50 in Figures 6 and 7, the only one that is inclined or tilted being cooling jig 70 (see line 54 of column 11 to line 14 of column 12 and FIGS. 7 (a) – (c) of the reference). While jig 52 in Figure 6 vibrates (col. 11, lines 42-53) and the melt in Figure 5 is vibrated as cooling jig 51a is inserted (col. 10, lines 52-54), inclined or tilted cooling jig 70 is not vibrated. Melts M1, M3, and M5 that are made to flow down inclining cooling jig 70 severally contain a refiner N formed of an Al-Ti-B alloy (lines 20 – 24 of column 10), a refiner N containing Ti (lines 42 – 47 of column 10), and a refiner N formed of an Al-Ti-B alloy (lines 11 – 15 of column 15). Adachi, however, does not disclose a specific structure for generating crystal nuclei in a molten metal without using any refiner.

Wognam discloses the use of a vibration mechanism for a mold surface used in the continuous casting of a billet or strip. This vibration is used to overcome friction in the mold and to propagate the casting forward from the mold. See col. 1, lines 30-40 and the paragraph bridging cols. 1-2 of the reference. Jones is similar in its disclosure of a mold used in the

continuous casting of a billet or strip that is vibrated in order to overcome friction. See col. 1, lines 36-44 and col. 5, lines 23-26 and Figs. 4, 5, 8 and 9 of Jones.

Wognum and Jones, however, neither disclose nor suggest a structure for forming fine primary crystals in a molten alloy without inducing formation of crystal nuclei in the molten alloy.

One of ordinary skill in the art would not combine Adachi with Wognam and optionally Jones to produce the present invention, as the purpose of Wognum's and Jones's vibration - to overcome frictional drag/move a cast product stuck in a mold forward - is not a problem for the tilted cooling jig of Adachi over which molten metal flows. This is in fact confirmed by Adachi itself, as vibration is used in several places by Adachi, but not for tilted cooling jig 70. Moreover, by using a tilted cooling body for setting a temperature of said molten metal at a level not higher than a liquidus temperature of magnesium alloy and not lower than a solidus temperature of magnesium alloy and giving vibration to the tilted cooling body as presently claimed, an important advantage can be realized:

As described at page 15 of the paper written by the inventors of the present U.S. patent application titled 'Study on Equiaxed Crystal by Direct Observation' (Journal of the Japan Institute of Metals, Vol. 35, No. 1 (1971), separate print 'Thesis'),[1] attached, when a molten metal is cooled on the surface of a cooling body, the nuclei of this molten metal are formed on the surface of the cooling body and allowed to gain growth.

In the present invention, the nuclei of the molten metal are liberated from the surface of the cooling body by vibration before they form a condensed shell possessing a phase boundary along the surface of the cooling body. The invention of the subject patent application, therefore, is capable of forming an equiaxed product, namely a spherical crystal, without using any additive.

Becasue magnesium alloy has the smallest specific gravity of the metals that are in actual use and is capable of causing virtually all impurities and chemicals to sediment to the bottom of the main body thereof, the invention as described in, in particular, claims 15, 18, 20 and 22 are capable of easily providing a clean magnesium alloy deprived of impurities. In this regard, the attached "Components of Magnaball" analysis shows the composition of a magnesium alloy rod (product name "Magball Billet") manufactured by using a continuous cast rod forming device (Fig. 1) to which Example 1 of the invention of the subject patent

[1] Further to the above-noted paper written in Japanese, the English translation of the paper is shown in 'Transactions of The Iron and Steel Institute of Japan, Vol. 11 (1971), "Origin of the Equiaxed Crystals in Castings", also attached.

application is applied.[2] The Si, Cu, Ni, and Fe that are contained in the magnesium alloy are impurities and these components are preferably removed from the alloy to the fullest possible extent.[3]

As is clear from the attached results the magnesium alloy rod ("Magball Billet") manufactured by the method of production of claim 15 or 20 has contents of Si, Cu, Ni, and Fe that are extremely low as compared with the a magnesium alloy rod ("unwrought Mg alloy for die casting") manufactured by conventional techniques. The following table shows the material properties of the magnesium alloy rod ("Magball AZ91D") manufactured by the method of production of claims 15 or 20 and the magnesium alloy rod ("Ingot AZ91D") manufactured by the conventional technique, which makes it clear that the magnesium alloy rod manufactured by the invention method is far superior to the conventional product in, e.g., tensile strength and proof stress:

	Magball AZ91D (product by this invention	Ingot AZ91D (product by conventional technique)
Specific gravity	1.80	1.81
Tensile strength	165	125
0.2% Proof stress (N/mm^2)	105	76
Specific strength	91	69
Specific hardness	58	41.9

[2] The continuous cast rod manufacturing device to which Example 1 is applied possesses the attributes of claim 15 or 20. In the table "AZ91D" denotes the specification of the magnesium alloy defined by the ASTM specification (American Society For Testing and Materials) and 'MD1D" denotes the specification of the magnesium alloy defined by the JIS specification (Japanese Industrial Standards).

[3] When magnesium is refined from the raw ore the Si left is magnesite or dolomite. Cu and Fe have the effect of causing the formation of rust. Since Mn is liable to form a compound with Al and exert an influence on the resultant composition, it is possible to lower the percentage of rejected articles by decreasing the content of Mn.

(In the table, "specific strength" = tensile strength/specific gravity and "specific hardness" = proof stress/specific gravity)

Further, the embodiments of claims 19, 20, 21, and 22 of the subject patent application enable the number of steps to be decreased and the duration of time for manufacture of a product to be shortened because they enable the quick preparation of a metal slurry and cast the metal slurry in the original form of spherical crystals (see, e.g., specification page 4, lines 19 ~ 21).

Accordingly, and because the combination of Adachi, Wognam and Jones fails to disclose or suggest the invention as presently claimed and provide the benefits discussed above, Applicants respectfully request the reconsideration and withdrawal of the outstanding rejections, and the passage of this case to Issue.

Respectfully submitted,

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Components of Magball

	Kind		Chemical Compositions (mass %)									
	ASTM	JIS	Al	Zn	Mn	Si	Cu	Ni	Fe	Be	Other Impurities	Mg
Example 1 of Magball billet	AZ91D	MD1D	8.99	0.75	0.19	0.02	0.005	0.0006	0.001	0.0010		Bal.
Example 2 of Magball billet			8.96	0.72	0.16	0.02	0.004	0.0006	0.001	0.0010		Bal.

※ The preceding data represent actual examples and no guaranteed values.

Unwrought Mg alloy for die casting (JIS H5222)	AZ91D	MD1D	8.5 – 9.5	0.45 – 0.9	0.17 – 0.40	No more than 0.05	No more than 0.025	No more than 0.001	No more than 0.004	※1	No more than 0.01	Bal.

※1 It is preferable to adjust the range of the content of beryllium (Be) of Magball within 0.0005～0.0015% so as to prevent Magball from oxidization.